

WHAT IS CLAIMED IS:

1. A computer readable medium containing code for controlling operation of a processor associated with a printing device, the code being executable to perform a method comprising:

operating the printing device for printing on a print medium in a primary mode in which the printing device consumes toner at a given rate, from a supply of the toner;

operating the printing device in a selected one of a plurality of secondary print modes for printing on a print medium, the secondary print modes consuming the toner at different rates lower than the given rate associated with the primary print mode of the printing device; and

switching operation of the printing device into a selected one of said plurality of secondary print modes so as to reduce a current rate of consumption of the toner as the supply of the toner is used.

2. The computer readable medium of claim 1, wherein the code further controls operation of the processor for:

associating ones of said secondary print modes having successively lower rates of consumption with successively lower levels of the supply of the toner;

responding to at least one input that changes as the level of the toner drops below a corresponding one of said successively lower levels; and

wherein said switching into said selected one of said secondary print modes is responsive to a change in the input indicating that the level of the toner has dropped below a threshold related to the corresponding one of said successively lower levels.

3. The computer readable medium of claim 1, wherein the code further controls operation of the processor such that said switching operation selects a secondary print mode configured to consume toner at a rate lower than a rate of the current print mode for at least one of: a) graphics regions; b) text regions; and c) graphics regions and text regions.

4. The computer readable medium of claim 3, wherein the secondary print mode selected is configured to consume toner at a rate lower than the current print mode for graphics regions by modifying dither patterns to reduce consumption of toner used to print a same said graphics region in the selected secondary print mode versus the current print mode.

5. The computer readable medium of claim 3, wherein the secondary print mode selected is configured to consume toner at a rate lower than the current print mode for text regions by character thinning to reduce consumption of toner used to print a same said text region in the selected secondary print mode versus the current print mode.

6. The computer readable medium of claim 5, wherein character thinning comprises eliminating application of the toner at pixels corresponding to portions of text characters according to a given reduction algorithm.

7. The computer readable medium of claim 3, wherein a first selected one of said secondary print modes is configured to have progressively decreased consumption of toner comprises a mode which reduces consumption of toner for graphics only information and wherein a subsequent selected one of said secondary print modes comprises a mode which reduces consumption of toner for graphics information and text information.

8. The computer readable medium of claim 1, wherein the code controls operation of the processor to alter application of at least one of a particulate powder contrast forming composition and a liquid ink contrast forming composition forming said toner.

9. An encoded medium containing code for controlling operation of a digital processor associated with a printing device, the processor managing application of a toner comprising a contrast forming composition, from a supply of the toner that can be exhausted by continued printing, wherein the processor is constrained by the code to perform the steps of:

varying a rate of toner consumption in the printing device, among a primary print mode in which the toner is consumed at a given rate, and a hierarchy of secondary print modes, each mode consuming a different amount of toner in printing predetermined image data, each said different amount being less than an amount consumed in the primary print mode, said hierarchy of print modes ranging in order from a mode having a greatest rate of toner consumption to a mode having a least rate of toner consumption;

associating predetermined levels of toner with corresponding modes of said hierarchy of secondary print modes;

receiving print requests; and

switching from a current print mode to one of said secondary print modes in response to a determination that a current level of toner has dropped below one of said predetermined levels, whereby each successive print mode switched to in said hierarchy in response to said print requests exhibits progressively decreased consumption of toner.

10. A method for controlling consumption of toner in a printing device having a supply of the toner, the printing device having a primary print mode at which the toner is consumed at a given rate, the method comprising:

providing a plurality of secondary print modes for printing on a print medium, configured to consume the toner at different rates lower than the given rate associated with the primary print mode of the printing device; and

switching operation of the printing device into a selected one of said plurality of secondary print modes so as to reduce a current rate of consumption of the toner as the supply of the toner is used.

11. The method of claim 10, further comprising:

associating ones of said secondary print modes having successively lower rates of consumption with successively lower levels of the supply of the toner;

detecting when the level of the toner has dropped below a corresponding one of said successively lower levels; and

wherein said switching into said selected one of said secondary print modes is done in response to said detecting when the level of the toner has dropped below a threshold related to the corresponding one of said successively lower levels.

12. The method of claim 10, wherein said switching comprises selecting a secondary print mode configured to consume toner at a rate lower than a rate of the current print mode for at least one of: a) graphics regions; b) text regions; and c) graphics regions and text regions.

13. The method of claim 12, wherein the secondary print mode selected is configured to consume toner at a rate lower than the current print mode for graphics regions by modifying dither patterns to reduce consumption of toner used to print a same said graphics region in the selected secondary print mode versus the current print mode.

14. The method of claim 12, wherein the secondary print mode selected is configured to consume toner at a rate lower than the current print mode for text regions by character thinning to reduce consumption of toner used to print a same said text region in the selected secondary print mode versus the current print mode.

15. The method of claim 14, wherein character thinning comprises eliminating application of the toner at pixels corresponding to portions of text characters according to a given reduction algorithm.

16. The method of claim 12, wherein a first selected one of said secondary print modes is configured to have progressively decreased consumption of toner comprises a mode which reduces consumption of toner for graphics only information and wherein a subsequent selected one of said secondary print modes comprises a mode which reduces consumption of toner for graphics information and text information.

17. The method of claim 10, wherein said toner comprises at least one of a particulate powder contrast forming composition and a liquid ink contrast forming composition.

18. A printing device having reduced toner consumption modes comprising:

a print processor responsive to an input signal for printing information on a print medium by application of toner from a supply;

memory for storing a hierarchy comprising a primary print mode and a plurality of secondary print modes, each mode in said hierarchy configured to consume progressively less toner to print a given image, whereby each of said modes consumes the toner at a progressively lower rate than the primary print mode of the printing device;

at least one detector for detecting when a level of toner in the supply drops below a given one of a plurality of threshold values and for generating a control signal in response thereto;

wherein said processor is responsive to said control signal for switching from a current print mode to a next one of said secondary print modes in said hierarchy based on said detection.

19. The device of claim 18, wherein the print processor includes a graphics processor responsive to a print request for graphics data for switching dither patterns to print graphics information in a reduced toner consumption mode.

20. The device of claim 18, wherein the print processor includes a text processor responsive to a print request for text data for removing pixel data from characters to print text information in a reduced toner consumption mode.

21. The device of claim 18, wherein said plurality of threshold levels and said hierarchy of secondary modes are configurable by a user.

22. The device of claim 18, wherein said detector comprises a plurality of sensors disposed in said printer for sensing toner level, each sensor associated with a corresponding one of said plurality of threshold levels and operative to generate said control signal when the sensed current toner level crosses said respective threshold level.

23. The device of claim 22, wherein said plurality of level sensors are disposed within a cartridge in said printer and arranged such that, as the level of toner in the cartridge is consumed by ongoing printing, successive ones of the sensors are exposed to air, thereby generating said control signals.

24. A printer comprising:

means responsive to an input for applying toner from a supply in the printer to a print media so as to form images containing at least one of characters, symbols, lines, graphics and pictures on the print media;

means defining a correspondence between the input and the images, said correspondence affecting a rate at which the toner is applied to form the images during printing;

means for assessing a level of the toner in the supply, and providing a signal representing said level;

means responsive to the signal representing said level, operable to switch from a primary print mode employing one rate at which the toner is applied, to a secondary print mode employing a lower rate at which the toner is applied;

wherein the printer is successively switched in response to the signal representing the level, to successively lower rates of application of the toner, as the supply is exhausted.



25. The printer of claim 24, wherein the means defining the correspondence between the input and the images comprises a digital storage medium for one of storing and loading alternative versions of images corresponding to the input, each of the versions employing a different level of consumption of the toner and being selected by said means operable to switch from the primary print mode to the secondary print mode.

26. The printer of claim 24, wherein the means defining the correspondence between the input and the images comprises a processor operable to vary the images produced in response to the input, according to alternative processed versions, each of the versions employing a different level of consumption of the toner and being selected by said means operable to switch from the primary print mode to the secondary print mode.

27. The printer of claim 24, wherein the correspondence between the input and the images is selectively switched to reduce an amount of toner used for a subset of the group consisting of characters, symbols, lines, graphics and pictures, when switching from the primary print mode to the secondary print mode.

28. A method for operating a printing device in a manner that varies a rate of toner consumption in the printing device, said toner comprising a contrast forming composition provided from a supply in the printing device that can be exhausted by continued printing, the printing device having a primary print mode in which the toner is consumed at a given rate, the method comprising:

establishing a hierarchy of secondary print modes, each mode consuming a different amount of toner in printing predetermined image data, each said different amount



being less than an amount consumed in the primary print mode, said hierarchy of print modes ranging in order from a mode having a greatest rate of toner consumption to a mode having a least rate of toner consumption;

associating predetermined levels of toner with corresponding modes of said hierarchy of secondary print modes;

receiving print requests; and

switching from a current print mode to one of said secondary print modes in response to a determination that a current level of toner has dropped below one of said predetermined levels, whereby each successive print mode switched to in said hierarchy in response to said print requests exhibits progressively decreased consumption of toner.

29. A computer readable medium encoded with computer program code such that, when the computer program code is executed by a processor of a computer, the processor performs a method comprising:

providing a plurality of secondary print modes for printing on a print medium, configured to consume toner at different rates, the different rates being lower than a given rate of toner consumption associated with a primary print mode for printing on a print medium; and

activating ones of said plurality of secondary print modes in response to a print request so as to reduce a current rate of consumption of toner as the supply of toner is used.